

REMARKS

I. Introduction

With the cancellation without prejudice of claims 16 and 17, claims 9 to 15 and 20 to 22 are pending in the present application. In view of the foregoing amendments and the following remarks, it is respectfully submitted that all of the presently pending claims are allowable, and reconsideration is respectfully requested.

II. Noncompliant Amendment of Claim 21

As an initial matter, the Examiner will note that claim 21 has been amended herein to address the indication that the previous amendment to claim 21 was not in compliance with 37 C.F.R. § 1.121.

III. Objection to the Specification

The Specification was objected to for various alleged informalities.

Regarding the objection to the term "PZT-based," the phrase "Lead-zirconate titanate ceramics $\text{Pb}(\text{Zr}_{1-x}\text{Ti}_x)\text{O}_3$ (PZT), modified by certain additives, have proven to be particularly advantageous" on page 1, lines 22 to 23 of the Specification has been changed to --Lead-zirconate titanate ceramics $\text{Pb}(\text{Zr}_{1-x}\text{Ti}_x)\text{O}_3$ (PZT), modified by certain additives, i.e., PZT-based ceramics, have proven to be particularly advantageous--. Thus, this amendment makes clear that PZT-based ceramics are ceramics, which have the general formula $\text{Pb}(\text{Zr}_{1-x}\text{Ti}_x)\text{O}_3$ (PZT) and may be modified by certain additives.

Regarding the alleged need to clarify the composition discussed in the Specification, the paragraph beginning on page 4, line 4 of the Specification has been amended to include the general formulas of PZT ceramics, which are proposed in WO 02/055450 A1, and whose sintering temperatures may be lowered by at least 100°C by adding ionic lithium directly prior to sintering. Support for this amendment may be found, for example, on page 4, lines 4 to 11 of the Specification, as well as from column 3, line 23 to column 4, line 19 of U.S. Patent No. 6,773,621, which constitutes the U.S. National Stage application of WO 02/055450 A1. Thus, this amendment makes clear the composition of the tested PZT compositions, including all of their substituents and dopants.

Regarding the incorrect spelling of the term "perovskite" on page 1, line 20 of the Specification, the Examiner will note that the spelling has been corrected.

Regarding the term "RB" in "RB-doping," it is respectfully submitted that "RB" simply refers to Robert Bosch GmbH, the assignee of U.S. Patent No. 6,773,621. Thus, although the Office Action is correct in stating that the term "RB" is not mentioned from column 3, line 23 to column 4, line 19, it is respectfully submitted that the above-mentioned amendment to the paragraph beginning on page 4, line 4 of the Specification sufficiently clarifies the term "RB-doping."

No new matter has been added. In view of all of the above, withdrawal of these objections is respectfully requested.

IV. Rejection of Claims 16 and 17 Under 35 U.S.C. § 112, 1st Paragraph

Regarding the rejection of claims 16 and 17 under 35 U.S.C. § 112, first paragraph, although Applicants may not agree with the merits of the rejection, to facilitate matters, claims 16 and 17 have been canceled without prejudice, thereby rendering moot the rejection with respect to these claims. Accordingly, withdrawal of this rejection is respectfully requested.

V. Rejection of Claims 9 to 15 and 21 Under 35 U.S.C. § 112, 2d Paragraph

Claims 9 to 15 and 21 were rejected under 35 U.S.C. § 112, second paragraph, as allegedly indefinite. It is respectfully submitted that these claims are sufficiently definite for at least the following reasons.

Although Applicants may not agree with the merits of the rejection, to facilitate matters, claim 9 has been amended, inter alia, to recite that a method for manufacturing a low-sintering PZT-based piezoelectric ceramic material includes mixing together ions added in the form of powdered oxides or powdered carbonates **of at least lead, zirconium and titanium** as starting compounds, thereby sufficiently clarifying what ions are mixed.

Regarding the alleged indefiniteness of the phrase "lithium in ionic form" in claim 9, although Applicants completely disagree with the merits of this part of the rejection, claim 9 has also been amended to recite that after calcining the starting compounds, lithium in **salt** form is added to the mixture in an amount in the range of 0.01 to 0.1 wt.% in relation to the weight of the PZT ceramic.

Regarding the terms "PZT compounds" and "the PZT base material," the Examiner will note that claim 11 has been amended to change the phrase "PZT compounds simply doped using rare earth metals are used as the PZT base materials" to --the starting compounds are simply doped using rare earth metals--,

thereby eliminating the terms "PZT compounds" and "the PZT base material." In addition, claims 13 to 15 have been amended in an analogous manner with respect to the above-mentioned terms. Support for these amendments may be found, for example, on page 3, lines 30 to 32 and page 4, lines 1 to 3 of the Specification.

Regarding the term "simply doped" in claims 11 and 13, it is once again respectfully submitted that this term is an alternative expression for "mono-doped." Support for this assertion may be found, for example, in the following passages on page 5, lines 20 to 24, and from page 3, line 30 to page 4, line 3 of the Specification:

It has been found that, in the case of **simply doped** PZT compositions, i.e., in contrast to compositions **doped with a plurality of dopants** using rare earth metals such as La or Nd, the sintering temperature is lowered by at least approximately 100°C. (Emphasis added);

and

It is advantageous, if compositions **simply doped** using rare earth metals, in particular La or Nb, are used as PZT basic materials.

Additional advantages result from the use of compositions **doped using combinations of elements** selected from the group made up of Ca, La, Nb, Fe, and Cu. (Emphasis added).

As is clear from the context of these passages, the term "simply doped" refers to doping with one dopant (i.e., mono-doping) as opposed to a plurality of dopants.

Regarding the alleged indefiniteness of claim 21, the Examiner will note that claim 21 has been amended to recite, in relevant part, that the actuator comprises a PZT-based low-sintering piezoelectric ceramic material **manufactured according to the method of Claim 9.**

Accordingly, it is respectfully submitted that claims 9 to 15 and 21 are sufficiently definite for at least the above reasons.

In view of all of the foregoing, withdrawal of this rejection is respectfully requested.

VI. Rejection of Claims 9 to 13 and 20 Under 35 U.S.C. § 102(b)

Claims 9 to 13 and 20 were rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 5,993,895 ("Jang et al."). It is respectfully submitted that Jang et. al do not anticipate these claims for at least the following reasons.

Jang et al. do not disclose, or even suggest, a method for manufacturing a low-sintering PZT-based piezoelectric ceramic material. Jang et al. describe a PLZT ceramic including lead, lanthanum, zirconium and titanium constituents. In addition, in column 3, line 51 to 57, Jang et al. indicate that the respective molar percentages of L, Zr and Ti in the tested PLZT ceramics were 1 to 10, 90 to 100 and 0 to 10. Thus, the molar percentages of lanthanum and titanium were essentially equal, and therefore, contrary to the contention appearing on page 6, lines 5 to 6 of the Office Action, the lanthanum in the PLZT ceramics described in Jang et al. is not a dopant, but a core constituent of the PLZT ceramic. As a result the PLZT ceramics described in Jang et al. cannot be considered lanthanum-doped PZT ceramics.

Furthermore, Jang et al. do not disclose, or even suggest, the feature of claim 9 that a sintering temperature in the range of 850°C to 950°C is obtained for a mixture of calcined starting compounds and ionic lithium. Jang et al. do describe mixtures of a PLZT powder and lithium nitrate, but these mixtures were disclosed to obtain sintering temperatures of 1000°C and 1100°C, and not 850°C to 950°C as required by the feature of claim 9. In addition, contrary to the contentions appearing on page 7, lines 3 to 4 and 16 to 19 of the Office Action, the claimed sintering temperature of Jang et al. of “not greater than about 1100°C” does not at all imply a range including any temperature less than or equal to 1100°C. The examples disclosed in Table 1 in column 5, lines 28 to 40 of Jang et al. have sintering temperatures ranging from 1000°C to 1950°C, and not from 850°C to 950°C. Moreover, in response to the assertion of the Office Action that “[t]he fact the examples teach sintering at 1000°C and 1100°C does not mean that it cannot be sintered in the claimed range,” the Examiner is respectfully reminded that the critical point is not the Examiner’s speculation regarding possible sintering temperatures of the compositions of Jang et al., but whether Jang et al. disclose a sintering temperature range of 850°C to 950°C. Jang et al. clearly do not disclose or suggest the aforementioned range.

Accordingly, it is respectfully submitted that Jang et al. do not anticipate claim 9 for at least the above reasons.

As for claims 10 to 13 and 20, which ultimately depend from claim 9 and therefore include all of the features of claim 9, it is respectfully submitted that Jang et al. do not anticipate these dependent claims for at least the reasons set forth above.

In view of all of the foregoing, withdrawal of this rejection is respectfully requested.

VII. Rejection of Claims 9 to 13 and 20 to 22 Under 35 U.S.C. § 103(a)

Claims 9 to 13 and 20 to 22 were rejected under 35 U.S.C. § 103(a) as unpatentable over Jang et al. It is respectfully submitted that Jang et. al do not render these claims unpatentable for at least the following reasons.

As discussed above in section VI of this response, Jang et al. do not disclose, or even suggest, all of the features of claim 9. Accordingly, it is respectfully submitted that Jang et al. do not render unpatentable claim 9 or its dependent claims 10 to 13 and 20 for at least these reasons.

Regarding claim 21, Jang et al. do not disclose, or even suggest a piezoelectric multilayer actuator having internal electrodes made of pure silver. As indicated in column 5, lines 56 to 62, Jang et al. only disclose a silver palladium alloy as metallization. In addition, as the melting point of silver is approximately 960°C (see page 4, lines 20 to 26 of the Specification), the sintering temperatures of 1000°C to 1950°C disclosed by Jang et al. would melt a silver electrode, thereby rendering the piezoelectric actuator nonfunctional. Accordingly, Jang et al. do not render claim 21 unpatentable for at least these reasons.

Regarding claim 22, as this claim relates to a motor vehicle fuel injection system including the piezoelectric multilayer actuator according to claim 21, it is respectfully submitted that Jang et al. do not render claim 22 unpatentable for at least the reasons set forth above in support of the patentability of claim 21.

In view of all of the foregoing, withdrawal of this rejection is respectfully requested.

VIII. Conclusion

In light of the foregoing, Applicants respectfully submit that all pending claims are in condition for allowance. Prompt reconsideration and allowance of the present application are therefore earnestly solicited.

Respectfully submitted,

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/Clifford A. Ulrich/
By: Clifford A. Ulrich, Reg. No. 42,194 for:
Gerard A. Messina
Reg. No. 35,952

KENYON & KENYON LLP
One Broadway
New York, NY 10004
Telephone: (212) 425-7200
Facsimile: (212) 425-5288
CUSTOMER NO. 26646